

CLAIMS

What is claimed is:

1. A filter device comprising:

2 a housing having a first end;

4 a first ring joinable to said first end wherein said first ring has a first annular anchor on an interior portion of said first ring;

6 a first flange cap joinable to said first ring forming a first seal;

8 a plurality of microfibers extending from said first ring through said housing, and

10 a first potting material encasing said plurality of microfibers at said first ring and encasing said first annular anchor forming a second seal.

2. The filter device according to claim 1 further comprising:

4 a second end of said housing opposite said first end;

6 a second ring joinable to said second end wherein said second ring has a second annular anchor on an interior portion of said second ring;

8 a second flange cap joinable to said second ring forming a third seal;

a second potting material encasing said plurality of
10 microfibers at said second ring and encasing said second annular
anchor forming a fourth seal.

3. The filter device according to claim 1 further
2 comprising:

a first fluid inlet port through said first flange cap;

4 a first fluid outlet port through said second flange cap,
wherein a first fluid pathway is defined by said first fluid
6 inlet port, said plurality of microfibers, and said first fluid
outlet port;

8 a second fluid inlet port through said housing and proximate
to said first end; and

10 a second fluid outlet port through said housing and
proximate to said second end, wherein a second fluid pathway is
12 defined by said second fluid inlet port, a space between said
plurality of microfibers, and said second fluid outlet port.

4. The filter device according to claim 1 wherein each of
2 said plurality of microfibers are hollow and semipermeable.

5. The filter device according to claim 1 wherein said
2 first annular anchor and said second annular anchor receive a
surface treatment, wherein said surface treatment modifies a
4 surface energy of said first annular anchor and said second
annular anchor.

6. The filter device according to claim 5 further
2 comprising:

a first plurality of rounded ridges on an upper surface of
4 said first annular anchor and a second plurality of rounded
ridges on a lower surface of said first annular anchor; and

6 a third plurality of rounded ridges on an upper surface of
said second annular anchor and a fourth plurality of rounded
8 ridges on a lower surface of said second annular anchor;

wherein said first and second plurality of rounded ridges
10 and said third and fourth plurality of rounded ridges on said
first and second annular anchors minimize a delamination of said
12 first and second potting materials from said first and second
annular anchors, and increases a surface area of said first and
14 second annular anchors treatable through said surface treatment.

7. The filter device according to claim 6 further
2 comprising:

a first plurality of radial channels perpendicular to said
4 first plurality of rounded ridges on said upper surface of said
first annular anchor; and

6 a second plurality of radial channels perpendicular to said
third plurality of rounded ridges on said upper surface of said
8 second annular anchor;

wherein said first and second plurality of radial channels
10 allow air to escape when said first and second potting material
is applied to said filter device.

8. The filter device according to claim 1 wherein said
2 first ring is spin welded to said first end, said second ring is
spin welded to said second end, said first flange cap is spin
4 welded to said first ring, and said second flange cap is spin
welded to said second ring.

9. The filter device according to claim 8 further
2 comprising:

a first plurality of nubs on an outer portion of said first
4 ring; and

a second plurality of nubs on an outer portion of said
6 second ring;

wherein said first and second plurality of nubs assist in
8 said spin welding.

10. The filter device according to claim 8 further
2 comprising:

at least one annular channel located between said first ring
4 and said first end; and

at least one annular channel located between said second
6 ring and said second end;

wherein each of said at least one annular channel
8 accommodates a flow of flash material during said spin welding.

11. The filter device according to claim 8 further
2 comprising:

at least one annular channel located between said first ring
4 and said first flange cap; and

at least one annular channel located between said second
6 ring and said second flange cap;

wherein each of said at least one annular channel
8 accommodates a flow of flash material during said spin welding.

12. The filter device according to claim 1 wherein said
2 first ring is laser welded to said first end, said second ring is
laser welded to said second end, said first flange cap is laser
4 welded to said first ring, and said second flange cap is laser
welded to said second ring.

13. The filter device according to claim 1 wherein said
2 housing is cylindrical in shape.

14 A filter device comprising:

2 a housing having a first end;

a first ring joinable to said first end wherein said first
4 ring has a first annular anchor on an interior portion of said
first ring;

6 a first flange cap joinable to said first ring forming a
first seal;

8 a plurality of microfibers extending from said first ring
through said housing;

10 a first potting material encasing said plurality of
microfibers at said first ring and encasing said first annular
12 anchor forming a second seal;

a first fluid inlet port through said first flange cap
14 wherein a first portion of a first fluid pathway is defined by
said first fluid inlet port and said plurality of microfibers;

16 and

a second fluid inlet port through said housing and proximate
18 to said first end wherein a first portion of a second fluid
pathway is defined by said second fluid inlet port and a space
20 between said plurality of microfibers.

15. The filter device according to claim 14 further

2 comprising:

a second end of said housing opposite said first end;

4 a second ring joinable to said second end wherein said
second ring has a second annular anchor on an interior portion of
6 said second ring;

a second flange cap joinable to said second ring forming a
8 third seal;

a second potting material encasing said plurality of
10 microfibers at said second ring and encasing said second annular
anchor forming a fourth seal;

12 a first fluid outlet port through said second flange cap
wherein a second portion of said first fluid pathway is defined
14 by said second fluid outlet port and said plurality of
microfibers; and

16 a second fluid outlet port through said housing and
proximate to said second end wherein a second portion of said
18 second fluid pathway is defined by said second fluid outlet port
and said space between said plurality of microfibers.

16. The filter device according to claim 14 wherein each of
2 said plurality of microfibers are hollow and semipermeable.

17. The filter device according to claim 14 wherein said
2 first annular anchor and said second annular anchor receive a
surface treatment, wherein said surface treatment modifies a
4 surface energy of said first annular anchor and said second
annular anchor.

18. The filter device according to claim 17 further
2 comprising:

4 a first plurality of rounded ridges on an upper surface of
said first annular anchor and a second plurality of rounded
ridges on a lower surface of said first annular anchor; and

6 a third plurality of rounded ridges on an upper surface of
said second annular anchor and a fourth plurality of rounded
8 ridges on a lower surface of said second annular anchor;

wherein said first and second plurality of rounded ridges
10 and said third and fourth plurality of rounded ridges on said
first and second annular anchors minimize a delamination of said
12 first and second potting materials from said first and second
annular anchors, and increases a surface area of said first and
14 second annular anchors treatable through said surface treatment.

19. The filter device according to claim 18 further
2 comprising:

4 a first plurality of radial channels perpendicular to said
first plurality of rounded ridges on said upper surface of said
first annular anchor; and

6 a second plurality of radial channels perpendicular to said
third plurality of rounded ridges on said upper surface of said
8 second annular anchor;

wherein said first and second plurality of radial channels
10 allow air to escape when said first and second potting material
is applied to said filter device.

20. The filter device according to claim 14 wherein said
2 first ring is spin welded to said first end, said second ring is
spin welded to said second end, said first flange cap is spin
4 welded to said first ring, and said second flange cap is spin
welded to said second ring.

21. The filter device according to claim 20 further
2 comprising:

a first plurality of nubs on an outer portion of said first
4 ring; and

a second plurality of nubs on an outer portion of said
6 second ring;

wherein said first and second plurality of nubs assist in
8 said spin welding.

22. The filter device according to claim 20 further
2 comprising:

at least one annular channel located between said first ring
4 and said first end; and

at least one annular channel located between said second
6 ring and said second end;

wherein each of said at least one annular channel
8 accommodates a flow of flash material during said spin welding.

23. The filter device according to claim 20 further
2 comprising:

at least one annular channel located between said first ring
4 and said first flange cap; and

at least one annular channel located between said second
6 ring and said second flange cap;

wherein each of said at least one annular channel
8 accommodates a flow of flash material during said spin welding.

24. The filter device according to claim 14 wherein said
2 first ring is laser welded to said first end, said second ring is
laser welded to said second end, said first flange cap is laser
4 welded to said first ring, and said second flange cap is laser
welded to said second ring.

25. The filter device according to claim 14 wherein said
2 housing is cylindrical in shape.

26. A filter device prepared by a process comprising the
2 steps of:

(a) joining a first ring to a first end of a housing
4 wherein said first ring has a first annular anchor on an interior
portion of said first ring;

6 (b) inserting a plurality of microfibers within said
housing that extend to said first ring;

8 (c) encasing said plurality of microfibers and said first
annular anchor at said first ring with a first potting material
10 forming a first seal; and

(d) joining a first flange cap to said first ring forming a
12 second seal.

27. A filter device prepared by a process according to
2 claim 26 wherein said encasing step (c) further comprises the
steps (c1) through (c6):

4 (c1) attaching a first potting cap to said first ring to
close off said first end;

6 (c2) placing said housing in a centrifuge to allow rotation
about an axis of rotation perpendicular to a longitudinal axis of
8 said housing, wherein said axis of rotation extends through a
midpoint of said housing;

10 (c3) injecting said first potting material into said housing
proximate to said first end;

12 (c4) spinning said housing in said centrifuge causing said
first potting material to set and harden, encasing said plurality

14 of microfibers and said first annular anchor at said first ring
at said first end forming said first seal;

16 (c5) removing said first potting cap; and

(c6) cutting said first potting material and said plurality
18 of microfibers at said first end through a first plane
perpendicular to said longitudinal axis, exposing an interior
20 channel of each of said plurality of microfibers at said first
end.

28. A filter device prepared by a process according to
2 claim 26 further comprising the steps of:

(e) joining a second ring to a second end of said housing
4 wherein said second ring has a second annular anchor on an
interior portion of said second ring;

6 (f) extending said plurality of microfibers within said
housing to said second ring;

8 (g) encasing said plurality of microfibers and said second
annular anchor at said second ring with a second potting material
10 forming a third seal; and

(h) joining a second flange cap to said second ring forming
12 a fourth seal.

29. A filter device prepared by a process according to
2 claim 28 wherein said encasing step (g) further comprises the
steps (g1) through (g6):

4 (g1) attaching a second potting cap to said second ring to
close off said second end;

6 (g2) placing said housing in said centrifuge to allow
rotation about said axis of rotation perpendicular to said
8 longitudinal axis of said housing, wherein said axis of rotation
extends through said midpoint of said housing;

10 (g3) injecting said second potting material into said
housing proximate to said second end;

12 (g4) spinning said housing in said centrifuge causing said
second potting material to set and harden, encasing said
14 plurality of microfibers and said second annular anchor at said
second ring at said second end of said housing forming said third
16 seal;

(g5) removing said second potting cap; and

18 (g6) cutting said second potting material and said plurality
of microfibers at said second end through a second plane
20 perpendicular to said longitudinal axis, exposing said interior
channel of each of said plurality of microfibers at said second
22 end.

30. A filter device prepared by a process according to
2 claim 28 wherein said joining steps (a), (d), (e), and (h)
further comprise the steps (a1), (d1), (e1), and (h1):

4 (a1) spin welding said first ring to said first end;

(d1) spin welding said second ring to said second end;

6 (e1) spin welding said first flange cap to said first ring;
and

8 (h1) spin welding said second flange cap to said second
ring.

31. A filter device prepared by a process according to
2 claim 30 further comprising:

forming a first plurality of nubs on an outer portion of
4 said first ring; and

forming a second plurality of nubs on an outer portion of
6 said second ring;

wherein said first and second plurality of nubs assist in
8 said spin welding.

32. A filter device prepared by a process according to
2 claim 30 further comprising:

forming at least one annular channel between said first ring
4 and said first end; and

forming at least one annular channel between said second
6 ring and said second end;

wherein each of said at least one annular channel
8 accommodates a flow of flash material during said spin welding.

33. A filter device prepared by a process according to
2 claim 30 further comprising:

forming at least one annular channel between said first ring
4 and said first flange cap; and
forming at least one annular channel between said second
6 ring and said second flange cap;
wherein each of said at least one annular channel
8 accommodates a flow of flash material during said spin welding.

34. A filter device prepared by a process according to
2 claim 28 wherein said joining steps (a), (d), (e), and (h)
further comprise the steps (a1), (d1), (e1), and (h1):

4 (a1) laser welding said first ring to said first end;
(d1) laser welding said second ring to said second end;
6 (e1) laser welding said first flange cap to said first ring;
and
8 (h1) laser welding said second flange cap to said second
ring.

35. A filter device prepared by a process according to
2 claim 26 further comprising:

forming a first fluid inlet port in said first flange cap;
4 forming a first fluid outlet port in said second flange cap;
forming a second fluid inlet port through said housing and
6 proximate to said first end; and

forming a second fluid outlet port through said housing and
8 proximate to said second end;

wherein a first fluid pathway is defined by said first fluid inlet port, said plurality of microfibers, and said first fluid outlet port; and

further wherein a second fluid pathway is defined by said second fluid inlet port, a space between said plurality of microfibers, and said second fluid outlet port.

36. A filter device prepared by a process according to claim 26 further comprising:

treating said first annular anchor and said second annular anchor with a surface treatment, wherein said surface treatment modifies a surface energy of said first annular anchor and said second annular anchor.

37. A filter device prepared by a process according to claim 36 further comprising:

forming a first plurality of rounded ridges on an upper surface of said first annular anchor;

forming a second plurality of rounded ridges on a lower surface of said first annular anchor;

forming a third plurality of rounded ridges on an upper surface of said second annular anchor; and

forming a fourth plurality of rounded ridges on a lower surface of said second annular anchor;

wherein said first and second plurality of rounded ridges and said third and fourth plurality of rounded ridges on said

first and second annular anchors minimize a delamination of said
14 first and second potting materials from said first and second
annular anchors, and increases a surface area of said first and
16 second annular anchors treatable through said surface treatment.

38. A filter device prepared by a process according to
2 claim 37 further comprising:

notching a first plurality of radial channels perpendicular
4 to said first plurality of rounded ridges on said upper surface
of said first annular anchor; and

6 notching a second plurality of radial channels perpendicular
to said third plurality of rounded ridges on said upper surface
8 of said second annular anchor;

wherein said first and second plurality of radial channels
10 allow air to escape when said first and second potting material
is applied to said filter device.

39. A filtering method comprising the steps of:

(a) providing a filter device having a first ring joinable to a first end of a housing wherein said first ring has a first annular anchor on an interior portion of said first ring, a plurality of microfibers within said housing that extend to said first ring, a first potting material encasing said plurality of microfibers and said first annular anchor at said first ring forming a first seal, a first flange cap joinable to said first ring forming a second seal, a second ring joinable to a second end of said housing wherein said second ring has a second annular anchor on an interior portion of said second ring, a second potting material encasing said plurality of microfibers and said second annular anchor at said second ring forming a third seal, and a second flange cap joinable to said second ring forming a fourth seal;

(b) flowing a first fluid through a first flow path defined by a first fluid inlet port in said first flange cap, through said plurality of microfibers, and flowing out of a first fluid outlet port in said second flange cap; and

(c) flowing a second fluid through a second flow path defined by a second fluid inlet port through said housing and proximate to said first end, through a space between said plurality of microfibers, and flowing out of a second fluid outlet port through said housing and proximate to said second end.

40. A filtering method according to claim 39 wherein said
2 first annular anchor and said second annular anchor are treated
with a surface treatment, wherein said surface treatment modifies
4 a surface energy of said first annular anchor and said second
annular anchor.

41. A filtering method according to claim 40 wherein said
2 first annular anchor has a first plurality of rounded ridges on
an upper surface and a second plurality of rounded ridges on a
4 lower surface, and said second annular anchor has a third
plurality of rounded ridges on an upper surface and a fourth
6 plurality of rounded ridges on a lower surface;

wherein said first and second plurality of rounded ridges
8 and said third and fourth plurality of rounded ridges on said
first and second annular anchors minimize a delamination of said
10 first and second potting materials from said first and second
annular anchors, and increases a surface area of said first and
12 second annular anchors treatable through said surface treatment.

42. A filtering method according to claim 41 wherein a
2 first plurality of radial channels are notched perpendicular to
said first plurality of rounded ridges on said upper surface of
4 said first annular anchor, and a second plurality of radial
channels are notched perpendicular to said third plurality of
6 rounded ridges on said upper surface of said second annular
anchor;

8 wherein said first and second plurality of radial channels
allow air to escape when said first and second potting material
10 is applied to said filter device.

43. A filtering method according to claim 39 wherein said
2 first fluid flowing in said first flow path flows in a
countercurrent direction to said second fluid flowing in said
4 second flow path.

44. A filtering method according to claim 39 wherein said
2 first fluid is blood and said second fluid is dialysate and
further comprising the steps of:

4 connecting an arterial blood line to said first fluid inlet
port;

6 connecting a venous blood line to said first fluid outlet
port;

8 connecting a dialysate supply line to said second fluid
inlet port;

10 connecting a dialysate return line to said second fluid
outlet port;

12 wherein impurities in said blood diffuse through said
plurality of microfibers into said dialysate, and further wherein
14 nutrients diffuse through said plurality of microfibers into said
blood.

45. A filter device comprising:

2 a housing having a first end;

4 a first ring joinable to said first end wherein said first
ring has a first annular anchor on an interior portion of said
first ring, and further wherein said first annular anchor
6 receives a surface treatment, wherein said surface treatment
modifies a surface energy of said first annular anchor;

8 a first flange cap joinable to said first ring forming a
first seal;

10 a plurality of microfibers extending from said first ring
through said housing, and

12 a first potting material encasing said plurality of
microfibers at said first ring and encasing said first annular
14 anchor forming a second seal.

46. The filter device according to claim 45 further
2 comprising:

a second end of said housing opposite said first end;

4 a second ring joinable to said second end wherein said
second ring has a second annular anchor on an interior portion of
said second ring, and further wherein said second annular anchor
6 receives said surface treatment, wherein said surface treatment
8 modifies a surface energy of said second annular anchor;

a second flange cap joinable to said second ring forming a
10 third seal; and

a second potting material encasing said plurality of
12 microfibers at said second ring and encasing said second annular
anchor forming a fourth seal.

47. The filter device according to claim 46 further
2 comprising:

a first fluid inlet port through said first flange cap;

4 a first fluid outlet port through said second flange cap,
wherein a first fluid pathway is defined by said first fluid
6 inlet port, said plurality of microfibers, and said first fluid
outlet port;

8 a second fluid inlet port through said housing and proximate
to said first end; and

10 a second fluid outlet port through said housing and
proximate to said second end, wherein a second fluid pathway is
12 defined by said second fluid inlet port, a space between said
plurality of microfibers, and said second fluid outlet port.

48. The filter device according to claim 46 further
2 comprising:

a first plurality of rounded ridges on an upper surface of
4 said first annular anchor and a second plurality of rounded
ridges on a lower surface of said first annular anchor; and

6 a third plurality of rounded ridges on an upper surface of
said second annular anchor and a fourth plurality of rounded
8 ridges on a lower surface of said second annular anchor;

wherein said first and second plurality of rounded ridges
10 and said third and fourth plurality of rounded ridges on said
first and second annular anchors minimize a delamination of said
12 first and second potting materials from said first and second
annular anchors, and increases a surface area of said first and
14 second annular anchors treatable through said surface treatment.

49. The filter device according to claim 48 further
2 comprising:

a first plurality of radial channels perpendicular to said
4 first plurality of rounded ridges on said upper surface of said
first annular anchor; and

6 a second plurality of radial channels perpendicular to said
third plurality of rounded ridges on said upper surface of said
8 second annular anchor;

wherein said first and second plurality of radial channels
10 allow air to escape when said first and second potting material
is applied to said filter device.

~~50. A filter device comprising:~~

~~2 a housing having a first end;~~

~~4 a first ring joinable to said first end wherein said first
ring has a first annular anchor on an interior portion of said
first ring;~~

~~6 a first plurality of rounded ridges on an upper surface of
said first annular anchor and a second plurality of rounded
8 ridges on a lower surface of said first annular anchor;~~

~~10 a first flange cap joinable to said first ring forming a
first seal;~~

~~12 a plurality of microfibers extending from said first ring
through said housing; and~~

~~14 a first potting material encasing said plurality of
microfibers at said first ring, and encasing said first plurality
of rounded ridges on said upper surface and said second plurality
16 of rounded ridges on said lower surface of said first annular
anchor, forming a second seal;~~

~~18 wherein said first and second plurality of rounded ridges on
said first annular anchor minimizes a delamination of said first
20 potting material from said first annular anchor.~~

~~51. The filter device according to claim 50 further
2 comprising:~~

~~a second end of said housing opposite said first end;~~

4 a second ring joinable to said second end wherein said
second ring has a second annular anchor on an interior portion of
6 said second ring;

a third plurality of rounded ridges on an upper surface of
8 said second annular anchor and a fourth plurality of rounded
ridges on a lower surface of said second annular anchor;

10 a second flange cap joinable to said second ring forming a
third seal; and

12 a second potting material encasing said plurality of
microfibers at said second ring, and encasing said third
14 plurality of rounded ridges on said upper surface and said fourth
plurality of rounded ridges on said lower surface of said second
16 annular anchor, forming a fourth seal;

wherein said third and fourth plurality of rounded ridges on
18 said second annular anchor minimizes a delamination of said
second potting material from said second annular anchor.

52. The filter device according to claim 51 further
2 comprising:

a first fluid inlet port through said first flange cap;

4 a first fluid outlet port through said second flange cap,
wherein a first fluid pathway is defined by said first fluid
6 inlet port, said plurality of microfibers, and said first fluid
outlet port;

8 a second fluid inlet port through said housing and proximate
to said first end; and

10 a second fluid outlet port through said housing and
proximate to said second end, wherein a second fluid pathway is
12 defined by said second fluid inlet port, a space between said
plurality of microfibers, and said second fluid outlet port.

53. The filter device according to claim 51 further
2 comprising:

a first plurality of radial channels perpendicular to said
4 first plurality of rounded ridges on said upper surface of said
first annular anchor; and

6 a second plurality of radial channels perpendicular to said
third plurality of rounded ridges on said upper surface of said
8 second annular anchor;

wherein said first and second plurality of radial channels
10 allow air to escape when said first and second potting material
is applied to said filter device.

54. The filter device according to claim 51 wherein said
2 first annular anchor and said second annular anchor receive a
surface treatment, wherein said surface treatment modifies a
4 surface energy of said first and second plurality of rounded
ridges on said first annular anchor and said third and fourth
6 plurality of rounded ridges on said second annular anchor, and
further wherein said first and second plurality of rounded ridges
8 and said third and fourth plurality of rounded ridges increases a

surface area of said first and second annular anchors treatable
10 through said surface treatment.

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55. A filter device comprising:

a housing having a first end;

a first ring joinable to said first end wherein said first ring has a first annular anchor on an interior portion of said first ring;

a first flange cap joinable to said first ring forming a first seal;

a plurality of microfibers extending from said first ring through said housing; and

a first potting material encasing said plurality of microfibers at said first ring and encasing said first annular anchor forming a second seal; and

at least one annular channel located between said first ring and said first flange cap;

wherein each of said at least one annular channel accommodates a residue material during said joining of said first flange cap to said first ring.

56. The filter device according to claim 55 further comprising:

a second end of said housing opposite said first end;

a second ring joinable to said second end wherein said second ring has a second annular anchor on an interior portion of said second ring;

a second flange cap joinable to said second ring forming a third seal;

10 a second potting material encasing said plurality of
microfibers at said second ring and encasing said second annular
anchor forming a fourth seal; and

12 at least one annular channel located between said second
ring and said second flange cap;

14 wherein each of said at least one annular channel
accommodates a residue material during said joining of said
16 second flange cap to said second ring.

57. The filter device according to claim 56 further
2 comprising:

a first fluid inlet port through said first flange cap;

4 a first fluid outlet port through said second flange cap,
wherein a first fluid pathway is defined by said first fluid
6 inlet port, said plurality of microfibers, and said first fluid
outlet port;

8 a second fluid inlet port through said housing and proximate
to said first end; and

10 a second fluid outlet port through said housing and
proximate to said second end, wherein a second fluid pathway is
12 defined by said second fluid inlet port, a space between said
plurality of microfibers, and said second fluid outlet port.

58. The filter device according to claim 56 further
2 comprising:

at least one annular channel located between said first ring
4 and said first end; and

at least one annular channel located between said second
6 ring and said second end;

wherein each of said at least one annular channel
8 accommodates a residue material during said joining of said
second ring to said second end.

59. The filter device according to claim 56 wherein said
2 first annular anchor and said second annular anchor receive a
surface treatment, wherein said surface treatment modifies a
4 surface energy of said first and second annular anchors.

60. The filter device according to claim 59 further
2 comprising:

a first plurality of rounded ridges on an upper surface of
4 said first annular anchor and a second plurality of rounded
ridges on a lower surface of said first annular anchor; and

6 a third plurality of rounded ridges on an upper surface of
said second annular anchor and a fourth plurality of rounded
8 ridges on a lower surface of said second annular anchor;

wherein said first and second plurality of rounded ridges
10 and said third and fourth plurality of rounded ridges on said
first and second annular anchors minimize a delamination of said
12 first and second potting materials from said first and second

annular anchors, and increases a surface area of said first and
14 second annular anchors treatable through said surface treatment.

61. The filter device according to claim 56 further
2 comprising:

a first plurality of radial channels perpendicular to said
4 first plurality of rounded ridges on said upper surface of said
first annular anchor; and

6 a second plurality of radial channels perpendicular to said
third plurality of rounded ridges on said upper surface of said
8 second annular anchor;

wherein said first and second plurality of radial channels
10 allow air to escape when said first and second potting material
is applied to said filter device.